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Detailed Sequence Stratigraphic Interpretation of Mixed Carbonate-Evaporite Reservoir Systems: The Permian (Zechstein) of Germany and the Lower Cretaceous of NE Mexico

Major hydrocarbon resources occur in mixed carbonate-evaporite reservoirs many of which are located in the Middle East. The Permian Zechstein of Germany and the Lower Cretaceous of NE Mexico provide excellent working models to predict reservoir/seal quality, distribution and compartmentalization.

The Upper Permian carbonate reservoir (Ca₂) in Germany is underlain by the Werra Anhydrite (A1) and sealed by the Basal Anhydrite (A2) and consists of marginal marine to deep marine carbonate facies reflecting seven depositional cycles of clean carbonate. Both the A1 and A2 are composed entirely of sulfate and can be subdivided into facies types ranging from supratidal to deep marine. These facies have characteristic seal qualities with sabkha, algal tidal flat, and salina facies being the best seals. Sulfate arenites display relatively poor seal integrity.

The carbonates and evaporites in NE Mexico were deposited in a shallow lagoon during the highstand systems tract of a Lower Cretaceous supersequence. Smaller-scale genetic units reflect changes in accommodation space and sea level fluctuations. Generally, thick evaporite-dominated cycles and sequences thin-and shallow-upward to carbonate dominated cycles. This stratigraphic arrangement suggests that the evaporites are related to the transgressive part of the sequences, although sabkha evaporites are also present in the regressive parts of the sequences.

Facies analysis in conjunction with a framework of high frequency cyclicity of mixed carbonate-evaporite depositional systems provides a powerful tool of predicting seal integrity of interbedded sulfate units as well as the quality of the carbonate reservoir layers in order to optimize completion strategies and field development.